REMARKS

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow.

This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

Claims 1-2, 4-5 and 14 are currently being amended. Support for amendments can be found throughout the Specification, for example on Figures 3-5. No new matter is added.

After amending the claims as set forth above, claims 1-14 are now pending in this application. Claims 15-16 are cancelled without prejudice or disclaimer.

I. Claim Rejections under 35 U. S. C. § § 102& 103 Over Otsuki, Kitabatake And Ohmi

Claims 1-3 and 14 are rejected under 35 U.S.C. § 102 (b) as being anticipated by or, in alternative, under 35 U.S.C. § 103 (a) as obvious over Otsuki (US 2002/0005213). Claims 4-6 and 16 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Kitabatake (US 2001/0015170). Claims 7-12 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Kitabatake as applied to claim 6, and further in view of Otsuki. Claim 13 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Kitabatake and Otsuki as applied to claim 12, and further in view of Ohmi '157 (US 6,348,157). Applicants respectfully traverse the above rejections.

A. Otsuki Fails To Anticipate Or Render Obvious Claims 1-3 And 14

Independent claim 1 is amended to recite single-crystalline silicon carbide or chemical vapor deposited polycrystalline silicon carbide wherein the single-crystalline silicon carbide or polycrystalline silicon carbide are free from sintering agent and have a surface with a concentration of metal impurities equal to or less than 1×10^{11} atoms/cm^2.

In contrast, Otsuki teaches a sintered silicon carbide that is manufacture by heating a mixture of the silicon carbide powder and a nonmetallic auxiliary sintering agent (*see* Otsuki, Paragraph [0046]). Otsuki further teaches that a substance which generates carbon in the presence of heat (e.g., organic compounds or carbon black and graphite) is used as the nonmetallic auxiliary sintering agent (*see* Otsuki, Paragraph [0047]-[0049]).

Applicants respectfully submit that the sintered silicon carbide of Otsuki would inherently contain sintering agent that is required during the synthesis process, in contrast to the single-crystalline silicon carbide or the chemical vapor deposited polycrystalline silicon carbide that are free from sintering agent recited in independent claim 1.

Claims 2 and 3 depend from claim 1, and thus are patentable for at least the same reasons as claim 1. Moreover, claim 2 is separately patentable because Otsuki fails to teach or render obvious a silicon carbide product that has a metal impurity level as low as less than $1x10^{10}$ atoms/cm^2. Support for this statement can be found in Otsuki disclosure, which explicitly shows that sintered silicon carbide has a Fe, Ni, and Cu impurities of 1.3×10^{10} atoms/cm^2 to 9.5×10^{10} atoms/cm^2 (*see* Otsuki, Table 1, Examples 1-5), significantly higher than 1×10^{10} atoms/cm^2, as recited in independent claim 2. Throughout its disclosure, Otsuki is completely silent regarding making a silicon carbide product that has a metal impurity level as low as less than $1x10^{10}$ atoms/cm^2, in contrast to claim 2.

Claim 14 also recites a silicon carbide product free from sintering agent, and is patentable for at least the same reasons as claim 1.

B. Kitabatake Fails To Render Obvious Claims 4-6 And 16

Independent claim 4 is amended to recite immersing the single-crystalline silicon carbide or the chemical vapor deposited polycrystalline silicon carbide free from sintering agent in an acid such that each of the iron or iron compound, Ni and Cu has a concentration of less than 1×10^{10} atoms/cm^2.

Independent claim 5 is amended to recite cleaning the single-crystalline silicon carbide or the chemical vapor deposited polycrystalline silicon carbide only by an acidic

solution such that each of the iron or iron compound, Ni and Cu has a concentration of less than 1×10^{10} atoms/cm^2.

Kitabatake teaches a method of cleaning a SiC surface which has a surface defect density of 10^8 cm^{-2} or less. However, Kitabatake is completely silent on cleaning or removing surface metal impurities, and thus fails to teach or render obvious independent claims 4 and 5.

The Office correctly acknowledges that Kitabatake fails to teach that surface metal impurities can be reduced to 1×10^{11} atoms/cm^2 or less, let alone iron or iron compound, Ni and Cu impurities all being less than 1×10^{10} atoms/cm^2, as recited in claims 4 and 5 (*see* Office Action, page 7, paragraph 22). However, the Office alleges that one of ordinary skill in the art would have reasonably expected to achieve the results as claimed by performing the method of Kitabatake (*see* Office Action, page 7, paragraph 22).

Applicants respectfully traverse the rejections because Kitabatake does not provide a reasonable expectation of success. In contrast to what is alleged in the Office Action, an acid solution does not necessarily dissolve Cu into Cu ions (i.e., does not necessarily remove Cu impurities from the solid phase). This is illustrated in attached Figures A and B.

Specifically, Figure A shows a potential pH diagram of Cu in an aqueous solution. Figure B shows a potential pH diagram of Cu on an interface of an aqueous solution and a silicon surface. As shown in Figure A, when pH is equal to or smaller than 7 and the oxidation-reduction potential is higher than 0.2V, and Cu is dissolved in the form of Cu^{2+} ion. In contrast, if the oxidation-reduction potential is not higher than 0.2V, Cu^{2+} ion would precipitate as metal Cu even when pH is equal to or smaller than 7. Referring to Figure B, Cu on the silicon surface does not dissolve unless pH is equal to or smaller than 7 and the oxidation-reduction potential is higher than 0.75V.

The comparative data of Figures A and B clearly indicate that the cleaning conditions are in fact highly substrate-specific (i.e., depending on what material is in contacted with the Cu impurities). In other words, different conditions would have to be used to remove Cu impurities from a SiC surface and from a silicon surface, as the materials in contact with the Cu impurities are different.

Accordingly, Kitabatake, completely silent regarding removing surface metal impurities and any specific pH of the cleaning solution to be used, does not provide a reasonable expectation of success of obtaining a SiC surface having iron or iron compound, Ni and Cu impurities all less than 1×10^{10} atoms/cm^2, as recited in claims 4-5. A *prima facie* obviousness is not established. MPEP 2143.02.

Claim 6 depends from claim 5, and thus is patentable for at least the same reasons as claim 5. Claim 16 is cancelled without prejudice or disclaimer.

C. The Combination Of Kitabatake And Otsuki Fails To Render Obvious Claims 7-12.

As explained above, Kitabatake fails to teach or render obvious a method to obtain on SiC surface an iron or iron compound, Ni and Cu impurities all less than 1×10^{10} atoms/cm^2, in contrast to independent claim 5.

Otsuki is recited for disclosing other features of dependent claims, but fails to cure the above-explained deficiencies of Kitabatake.

Claims 7-12 depend from claim 5, and thus are patentable for at least the same reasons as claim 5.

D. The Combination Of Kitabatake, Otsuki And Ohmi '157 Fails To Render Obvious Claim 13.

Ohmi '157 are cited for disclosing other features of the claims, but fail to cure the above deficiencies of Kitabatake and Otsuki. Specifically, Ohmi '157 is related to a method of cleaning silicon, which requires a cleaning method completely different from silicon carbide material. In fact, if the cleaning solution of Otsuki is used to clean a silicon substrate of Ohmi '157, the silicon substrate of Ohmi '157 itself would have been dissolved in the mix of hydrofluoric and nitric acid of Otsuki cleaning solution.

Claim 13 depends from claim 5, and thus is patentable for at least the same reasons as claim 5.

Moreover, claim 13 is separately patentable because none of the prior art teaches to use a combination of sulfuric acid and hydrogen peroxide solution to clean a SiC surface, let alone a single-crystalline silicon carbide or polycrystalline silicon carbide recited in claim 5. Specifically, Otsuki teaches to clean a sintered silicon carbide by using an aqueous solution containing hydrofluoric acid and nitric acid (*see* Otsuki, paragraph [0124], Example 2) or an aqueous solution of a mixture of hydrofluoric acid, nitric acid, and sulfuric acid (*see* Otsuki, Example 5), but is completely silent on using a combination of sulfuric acid and hydrogen peroxide solution to clean a SiC surface, let alone a single-crystalline silicon carbide or polycrystalline silicon carbide recited in claim 5.

For at least the above reasons, Applicants respectfully request a withdrawal of the section 102 rejections over Kitabatake, Otsuki and Ohmi '157.

II. Claim Rejections under 35 U. S. C. § 103 Over Chinone And Sibley

Claims 4-5, 14 and 16 are rejected under 35 U.S.C. § 103 (a) as being unpatentable over Chinone (Chinone et al., "Applications of High Purity SiC Prepared by Chemical Vapor Deposition"). Claim 15 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Chinone as applied to claim 5, and further in view of Sibley (US 5,443,649). Applicants respectfully traverse the above rejections.

As explained above, Independent claim 4 is amended to recite immersing the single-crystalline silicon carbide or the chemical vapor deposited polycrystalline silicon carbide free from sintering agent in an acid such that each of the iron or iron compound, Ni and Cu has a concentration of less than 1×10^{10} atoms/cm^2. Independent claim 5 is amended to recite cleaning the single-crystalline silicon carbide or the chemical vapor deposited polycrystalline silicon carbide only by an acidic solution such that each of the iron or iron compound, Ni and Cu has a concentration of less than 1×10^{10} atoms/cm^2.

Chinone discloses various applications of chemical vapor deposited SiC, and teaches to treat the polycrystalline silicon carbide in fluorolic nitric acid to etch a very thin oxide film (*see* Chinone, page 200, section 3-1). However, Chinone is silent on, and for same reasons provided above regarding Kitabatake does not provide a reasonable expectation of, obtaining

a SiC surface having iron or iron compound, Ni and Cu impurities all less than 1×10^{10} atoms/cm^2, as recited in claims 4-5.

Sibley is cited for disclosing other features of dependent claims, but fails to cure the above-explained deficiencies of Chinone.

Claim 14 depends from claim 5, and thus is patentable for at least the same reasons as claim 5. Claims 15-16 are cancelled without prejudice or disclaimer.

Accordingly, Applicants respectfully request a withdrawal of the section 102 rejections over Chinone and Sibley.

III. Conclusion

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing or a credit card payment form being unsigned, providing incorrect information resulting in a rejected credit card transaction, or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicants hereby petition for such extension under 37 C.F.R. §1.136 and authorize payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

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